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Insect gall occurrence in savanna and forest remnant sites of Hidrolândia, GO, Brazil Central

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Abstract. In this study we perform an inventory of the insect galls in savanna and forest sites of Hidrolândia, Goiás, Brazil. We found 150 insect gall morphotypes, distributed on 39 botanical families and 104 plant species. Among the insect galls, 81 gall morphotypes were recorded in the savanna site and 73 in the forest site. The plant taxa richest in insect galls were the family Fabaceae with 22 gall morphotypes, the genus *Bauhinia* (Fabaceae) with 15, and the species *Siparuna guianensis* (Siparunaceae) with seven gall morphotypes. We found gall-inducing insects belonging to orders Diptera, Coleoptera, Lepidoptera and Thysanoptera. The galling insects of family Cecidomyiidae (Diptera) were the most common inducing 48.1% of the gall morphotypes. This is the first systematic survey of insect galls realized in the city of Hidrolândia, being this the site with the higher insect gall diversity already cataloged to the Central region of Brazil.

Key-Words. Cerrado; Fabaceae; Host plants; Insect galls; Plant-insect interaction.

INTRODUCTION

Galls are abnormal modifications in the vegetal tissues induced mainly by galling insects, and characterized by hypertrophy and hyperplasia of plant cells (Mani, 1964; Shorthouse & Rohfritsch, 1992). From an evolutionary point of view, insect galls are extended phenotypes of the gall-inducers (Stone & Schönrogge, 2003), which leads to each species of galling insect induces a specific morphotype of gall on their host plant (Carneiro *et al.,* 2009a). Galls and galling insects are widely distributed around the globe, especially in the Neotropical region (Espírito-Santo & Fernandes, 2007). In the Neotropics stand out Amazon (Julião *et al.,* 2014), Atlantic Forest (Santos *et al.,* 2014) and Cerrado (Araújo *et al.,* 2014a) as hotspots of insect gall diversity.

The Brazilian Cerrado is composed by a wide variety of vegetation types (Ribeiro & Walter, 2008), and one of the richest floras of Brazil and in the world (Klink & Machado, 2005; Mendonça *et al.,* 2008). This great structural and floristic diversity is one of the main explanations for the high insect gall diversity in the Cerrado (Araújo *et al.,* 2014a). In this sense, although the number of insect gall studies in the Cerrado has been growing in the recent years (Araújo *et al.,* 2014a), evidence points that there are still temporal and spatial gaps in the group sampling (*e.g.,* Araújo, 2011; Maia *et al.,* 2014).

To the Central Brazil, insect gall inventories have been published only to the following localities: Caldas Novas (Santos *et al.,* 2012), Goiânia (Santos *et al.,* 2010; Silva *et al.,* 2015), Parque Estadual da Serra dos Pireneus (Araújo *et al.,* 2011), and Parque Nacional das Emas (Araújo *et al.,* 2014b). Given these gaps in knowledge of insect galls in the Central Brazil, in the present study we perform an inventory of the insect galls and their host plants in sites of savanna and forest in Hidrolândia, Goiás, Central Brazil.

MATERIALS AND METHODS

The study was realized in the Escola Agrícola (EA) of the Centro de Formação Agroecológico de Hidrolândia (CEFAEH) in the city of Hidrolândia, State of Goiás, Central Brazil (17°00'56"S, 49°12'00"W; Fig. 1). The climate of region is classified as Aw of Köppen, being humid tropical with wet summer and dry winter. EA-CEFAEH has an area of approximately 40 hectares, most covered by natural vegetation with some level of human disturbance. The area is under Cerrado domain being characterized by several vegetation types, such as grasslands (*e.g.,* Rocky Field), savannas (*e.g.,* Cerrado *Sensu Stricto* or Neotropical savanna) and forests (*e.g.,* Semidecidual Forest and Gallery Forest) (Ribeiro & Walter, 2008).

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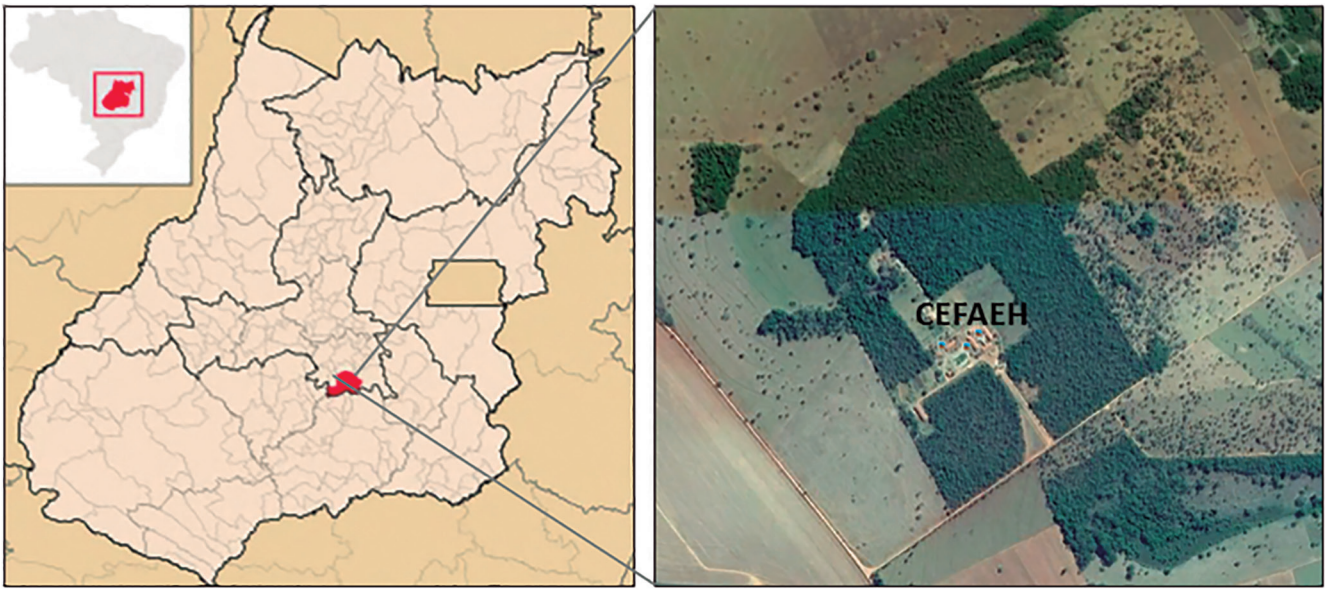

Figure 1. Localization of study area in the CEFAEH, Hidrolândia, Goiás, Central Brazil. Font: Google Earth.

The sampling was done monthly between September 2011 and May 2012 in two vegetation remnants being one of Cerrado *Sensu Stricto* (hereafter called savanna; 17°01'05"S; 49°11'49"W) and other of Semidecidual Forest (hereafter called forest; 17°00'42"S; 49°12'04"W). We performed the collect of insect galls along two transects (one in each vegetation type) sampled by two hours (Araújo *et al.,* 2011). All host plants had their epigeous parts inspected and all observed insect galls were registered. Samples of each insect galls were photographed, collected and transported individually in labeled plastic bags.

The collected insect galls were taken to the laboratory of Universidade Federal de Goiás (UFG) and packed in plastic container with moistened paper. Insect galls were identified in morphotypes using the host plant species and the gall characteristics (organ of occurrence, form, color, pubescence, and size). In laboratory, the galls were daily observed to verify the emergence of adult insects or dissected to obtainment of immature insects. All obtained insects were fixed in 70% alcohol and identified using the insect gall literature to Neotropics and Brazil (*e.g.,* Gagné, 1994; Maia & Fernandes, 2004, Araújo *et al.,* 2011). The identification of the host plant species was made by comparison with the collection of UFG herbarium. We checked plant species nomenclature and synonymy using The Plant List (http://theplantlist.org).

RESULTS AND DISCUSSION

We found 150 insect gall morphotypes distributed on 39 botanical families and 104 plant species in the EA-CEFAEH (Table 1). Previous studies that inventoried the insect gall diversity in the Cerrado sites ranged from 22 (Urso-Guimarães *et al.,* 2003) to 241 (Carneiro *et al.,* 2009b) gall morphotypes. The insect gall richness recorded in the present study is almost twice of 86.8 morphotypes, which is the average number of gall morphotypes recorded in the different surveys performed in the Brazilian Cerrado (review in Araújo *et al.,* 2014a). For studies in Central region of Brazil, the insect gall richness in the EA-CEFAEH exceeds all previously cataloged sites (Table 2), as for example, the Parque Nacional das Emas that had 97 gall morphotypes recorded (Araújo *et al.,* 2014b). Additionally, the average number of gall morphotypes per host plant species was of 1.44 in the present study, which was very similar to mean of 1.5 listed to Cerrado (Araújo *et al.,* 2014a). These variations in the number of insect gall morphotypes and galls per plant species can be explained by differences in the sampling efforts and number of sampled host plants in the different inventories.

The plant families richest in insect galls were Fabaceae, with 22 gall morphotypes, Malpighiaceae with 13, Sapindaceae with 11, and Erythroxylaceae and Myrtaceae with nine gall morphotypes each (Table 1). Our results are according to previous studies that point Fabaceae as the most important host family of insect galls in the Cerrado (*e.g.,* Maia & Fernandes, 2004; Santos *et al.,* 2010; Araújo *et al.,* 2011; Santos *et al.,* 2012; Silva *et al.,* 2015). The main explanation for the high insect gall richness hosted by Fabaceae in the Cerrado is its high species number (Southwood, 1960, 1961; Araújo *et al.,* 2014a) of nearly 800 (Mendonça *et al.,* 2008). Malpighiaceae and Myrtaceae also frequently appear in the ranking of insect gall host families most important of Cerrado (Araújo *et al.,* 2014a).

The plant genera *Bauhinia* (Fabaceae), *Erythroxylum* (Erythroxylaceae), *Myrcia* (Myrtaceae), and *Siparuna* (Siparunaceae) were the most diverse hosts of insect galls with 15, nine, seven, and seven gall morphotypes, respectively (Table 3). The plant species *Siparuna guianensis* (Siparunaceae), *Bauhinia brevipes* (Fabaceae), and *Erythroxylum* sp. (Erythroxylaceae), with seven, six, and five gall morphotypes, respectively, were the most important

Table 1. Number of host plant species and insect gall morphotypes in the host plant families recorded in EA-CEFAEH, Hidrolândia, Goiás, Brazil.

Host plant family	Number of plant species	Number of gall morphotypes	Gall richness per vegetation types		
			Savanna	Savanna/Forest	Forest
Anacardiaceae	2	2	2	0	0
Annonaceae	2	4	2	0	2
Apocynaceae	2	4	2	0	2
Araliaceae	1	1	1	0	0
Asteraceae	1	2	2	0	0
Bignoniaceae	1	1	0	0	1
Burseraceae	1	2	0	0	2
Caryocaraceae	1	2	1	1	0
Celastraceae	2	2	2	0	0
Combretaceae	1	2	2	0	0
Connaraceae	3	4	4	0	0
Dilleniaceae	1	2	2	0	0
Ebenaceae	1	1	1	0	0
Elaeocarpaceae	1	2	0	0	2
Erythroxylaceae	3	9	5	0	4
Euphorbiaceae	3	4	3	0	1
Fabaceae	6	22	17	0	5
Lamiaceae	1	2	2	0	0
Lauraceae	2	4	0	0	4
Lorantaceae	1	1	0	0	1
Lythraceae	1	1	0	0	1
Malpighiaceae	6	13	7	0	6
Melastomataceae	3	6	4	0	2
Meliaceae	1	3	0	0	3
Myristicaceae	1	1	0	0	1
Myrtaceae	2	9	2	0	7
Nyctaginaceae	1	1	1	0	0
Ochnaceae	1	1	1	0	0
Proteaceae	1	3	3	0	0
Rhamnaceae	1	1	0	0	1
Rubiaceae	2	5	0	0	5
Rutaceae	1	1	1	0	0
Santalaceae	1	1	0	0	1
Sapindaceae	3	11	4	0	7
Siparunaceae	1	7	0	0	7
Smilacaceae	1	3	2	0	1
Styracaceae	1	1	0	0	1
Vitaceae	3	3	2	0	1
Vochysiaceae	4	6	3	2	1
TOTAL	**71**	**150**	**78**	**3**	**69**

host plant species. Recent studies have recorded *Bauhinia* as a very diverse host plant genus of insect galls, which probably is due to genus be very speciose (Costa *et al.,* 2014; Nogueira *et al.,* 2016). The species *S. guianensis* and *B. brevipes* also have been previously recorded as important hosts of insect galls (Coelho *et al.,* 2014; Silva *et al.,* 2015). In our study, the most of recorded insect galls occurred on leaves (66.8%) and stems (24.1%), which corroborates the pattern of that Neotropical insect galls are more common in leaves and branches (Fernandes *et al.,* 1988; Santos *et al.,* 2010; Araújo *et al.,* 2011). Insect gall morphotypes also vary greatly in form, color and trichome presence or absence (Table 3), being that the most common were globoids (43.3%), greens (43.3%) and glabrous (61.1%). This great variation in the insect gall morphology can be explained by high specificity of gall-inducing insects associated to their host plants (Carneiro *et al.,* 2009a).

In this study we found gall-inducing insects belonging to orders Diptera, Coleoptera, Lepidoptera and Thysanoptera (Table 4). The Figs. 2-8 illustrates the gall morphotypes induced by galling insects. The most common galling taxon was Cecidomyiidae (Diptera), which induced 48.1% of the insect gall morphotypes. Galling insects of other taxonomic groups were much less frequent (only 7.2%), while from 44.7% of the insect gall morphotypes we did not find taxa of gall-inducers. Our results corroborate previous studies in the Brazilian savannas that point the dominance of Cecidomyiidae (Maia & Fernandes, 2004; Santos *et al.,* 2010; Araújo *et al.,* 2011), which is considered the main galling insect group of world (Gagné, 2010). The high cecidomyiid diversity in the Cerrado is hypothesized to be due to richest flora and the strongly opportunistic adaptive radiation of group (Araújo *et al.,* 2014a). Besides of gall-inducing insects, we also record several hymenopteran parasitoids from families Braconidae, Encyrtidae, Eulophidae, Eurytomidae, Pteromalidae and Torymidae. Hymenopteran parasitoids are very frequently in Neotropical insect galls (Fernandes & Santos, 2014) and are the main natural enemies of Cecidomyiidae (Maia & Azevedo, 2009).

Of the 150 insect gall morphotypes recorded in our study, 81 were recorded in the savanna site and 73 in the forest site. Only the globoid gall morphotype (Gall 18) recorded on *Caryocar brasiliense* (Caryocaraceae), the conical gall morphotype (Gall 76) of *Diplopterys*

Table 2. Comparison between the insect gall surveys performed in different areas of Brazil Central.

Surveys		Sampling		Number of recorded taxa			Reference
Locality	Coordinates	Collect period	Vegetation studied	Host plant families	Host plant species	Insect gall species	
EA-CEFAEH	17°00'S, 49°12'W	September 2011 to May 2012	Semidecidual Forest, Savanna	39	104	150	Present study
Campus Samambaia da UFG	16°36'S, 49°15'W	January 2005 to January 2007	Semidecidual Forest	12	20	34	Santos *et al.* (2010)
Parque Estadual da Serra dos Pireneus	15°48'S, 48°52'W	August 2006 to July 2008	Gallery and Semidecidual Forest, Savanna	28	51	62	Araújo *et al.* (2011)
Caldas Novas	17°42'S, 48°38'W	November 2008 to August 2009	Savanna	21	34	56	Santos *et al.* (2012)
Parque Nacional das Emas	17°49'S, 52°39'W	November 2013	Grassland, Savanna	24	44	97	Araújo *et al.* (2014b)
Mata da Veterinária	16°36'S, 49°16'W	September 2009 to April 2010	Semidecidual Forest	20	22	42	Silva *et al.* (2015)

Table 3. Host plants, insect gall morphotypes and insect taxa recorded in savanna and forest remnant sites of EA-CEFAEH, Hidrolândia, Goiás, Brazil. Legend: Gall size: L = Length, W = Width; Vegetation type: S = Savanna, F = Forest.

Host plants			Insect gall morphotypes						Insect taxa	
Family	Species	Gall	Organ	Form	Colour	Pubescence	Size (cm)	Vegetation	Gall-inducers	Parasitoids or inquilines
Anacardiaceae	*Anacardium humile* A. St.-Hil.	1	Leaf	Conical	Yellow	Glabrous	L ± 0.4; W ± 0.4	S	Cecidomyiidae	
Anacardiaceae	*Myracrodruon urundeuva* M. Allemão	2	Leaf	Conical	Brown	Hairy	L ± 0.5; W ± 0.4	S	Cecidomyiidae	
Annonaceae	Annonaceae sp.	3	Leaf	Discoid	Yellow	Hairy	L ± 0.1; W ± 0.1	S	Unidentified	
Annonaceae	Annonaceae sp.	4	Leaf	Discoid	Yellow	Hairy	L ± 0.2; W ± 0.2	S	Unidentified	
Annonaceae	Annonaceae sp.	5	Stem	Globose	Brown	Glabrous	L ± 1.3; W ± 1.3	F	Unidentified	
Annonaceae	*Cardiopetalum* sp.	6	Apical bud	Fusiform	Green	Hairy	L ± 0.3; W ± 0.2	F	Unidentified	
Apocynaceae	*Aspidosperma* sp.	7	Leaf	Globose	Green	Glabrous	L ± 0.3; W ± 0.3	F	Cecidomyiidae	Pteromalidae
Apocynaceae	*Aspidosperma* sp.	8	Leaf	Globose	Green	Glabrous	L ± 0.5; W ± 0.5	S	Cecidomyiidae	
Apocynaceae	*Aspidosperma* sp.	9	Stem	Fusiform	Brown	Glabrous	L ± 2.0; W ± 0.5	F	Cecidomyiidae	
Apocynaceae	*Aspidosperma tomentosum* Mart.	10	Leaf	Globose	Green	Hairy	L ± 0.3; W ± 0.3	S	Cecidomyiidae	
Araliaceae	*Schefflera macrocarpa* (Cham. & Schltdl.) Frodin	11	Leaf	Globose	Green	Hairy	L ± 0.1; W ± 0.1	S	Cecidomyiidae	
Asteraceae	Asteraceae sp.	12	Midvein	Globose	White	Hairy	L ± 0.7; W ± 0.5	S	Unidentified	
Asteraceae	Asteraceae sp.	13	Stem/Petiole	Globose	Green	Glabrous	L ± 1.0; W ± 1.0	S	Unidentified	
Bignoniaceae	*Fridericia* sp.	14	Stem	Fusiform	Brown	Hairy	L ± 1.7; W ± 0.7	F	Cecidomyiidae	
Burseraceae	*Protium* sp.	15	Leaf	Globose	Yellow	Glabrous	L ± 0.3; W ± 0.3	F	Cecidomyiidae	
Burseraceae	*Protium* sp.	16	Leaf/Stem/Petiole	Fusiform	Green	Glabrous	L ± 0.6; W ± 0.6	F	Cecidomyiidae	
Caryocaraceae	*Caryocar brasiliense* A. St.-Hil.	17	Leaf	Discoid	Yellow	Hairy	L ± 0.3; W ± 0.3	S	Cecidomyiidae	
Caryocaraceae	*Caryocar brasiliense* A. St.-Hil.	18	Leaf	Globose	Yellow	Hairy	L ± 0.3; W ± 0.3	S/F	Cecidomyiidae	Eulophidae/ Eurytomidae/ Torymidae
Celastraceae	Celastraceae sp.	19	Leaf	Discoid	Green	Glabrous	L ± 0.3; W ± 0.3	S	Unidentified	
Celastraceae	*Plenckia populnea* Reissek	20	Stem	Globose	Brown	Glabrous	L ± 1.5; W ± 1.5	S	Cecidomyiidae	Braconidae
Combretaceae	*Terminalia argentea* Mart.	21	Leaf	Discoid	Green	Hairy	L ± 0.3; W ± 0.3	S	Cecidomyiidae	
Combretaceae	*Terminalia argentea* Mart.	22	Leaf	Globose	Brown	Hairy	L ± 0.7; W ± 0.7	S	Cecidomyiidae	
Connaraceae	Connaraceae sp.	23	Inflorescence	Globose	Brown	Glabrous	L ± 0.7; W ± 0.7	S	Cecidomyiidae	Eurytomidae
Connaraceae	*Connarus* sp.	24	Leaf	Globose	Brown	Glabrous	L ± 0.5; W ± 0.5	S	Cecidomyiidae	
Connaraceae	*Connarus* sp.	25	Stem	Fusiform	Brown	Glabrous	L ± 2.5; W ± 1.0	S	Unidentified	Eulophidae
Connaraceae	*Connarus suberosus* Planch.	26	Leaf	Discoid	Green	Glabrous	L ± 0.3; W ± 0.3	S	Cecidomyiidae	
Dilleniaceae	*Davilla* sp.	27	Inflorescence	Fusiform	Green	Hairy	L ± 1.0; W ± 0.5	S	Lepidoptera	
Dilleniaceae	*Davilla* sp.	28	Leaf	Discoid	Yellow	Glabrous	L ± 0.3; W ± 0.3	S	Cecidomyiidae	
Ebenaceae	*Diospyros hispida* A. DC.	29	Apical bud	Globose	Green	Hairy	L ± 3.0; W ± 3.0	S	Lepidoptera	
Elaeocarpaceae	*Sloanea* sp.	30	Leaf	Globose	Green	Glabrous	L ± 0.4; W ± 0.3	F	Unidentified	
Elaeocarpaceae	*Sloanea* sp.	31	Leaf	Globose	Brown	Hairy	L ± 0.4; W ± 0.4	F	Unidentified	
Erythroxylaceae	*Erythroxylum* sp.	32	Leaf	Amophous	Green	Glabrous	L ± 1.0; W ± 0.2	S	Cecidomyiidae	
Erythroxylaceae	*Erythroxylum* sp.	33	Leaf	Discoid	Green	Glabrous	L ± 0.2; W ± 0.2	F	Cecidomyiidae	Eulophidae
Erythroxylaceae	*Erythroxylum* sp.	34	Leaf	Discoid	Green	Glabrous	L ± 0.4; W ± 0.4	F	Cecidomyiidae	
Erythroxylaceae	*Erythroxylum* sp.	35	Leaf	Globose	Brown	Hairy	L ± 0.6; W ± 0.6	S	Cecidomyiidae	Pteromalidae
Erythroxylaceae	*Erythroxylum* sp.	36	Leaf	Globose	Brown	Hairy	L ± 0.5; W ± 0.5	S	Cecidomyiidae	
Erythroxylaceae	*Erythroxylum* sp.	37	Midvein	Globose	Brown	Hairy	L ± 0.5; W ± 0.5	F	Cecidomyiidae	Pteromalidae
Erythroxylaceae	*Erythroxylum* sp.	38	Stem	Globose	Brown	Glabrous	L ± 0.6; W ± 0.6	F	Cecidomyiidae	
Erythroxylaceae	*Erythroxylum suberosum* A. St.-Hil.	39	Leaf	Globose	Brown	Hairy	L ± 2.0; W ± 2.0	S	*Myrciariamyia admirabilis* Maia & Fernandes, 2007 (Cecidomyiidae)	Encyrtidae/ Eulophidae/ Torymidae
Erythroxylaceae	*Erythroxylum tortuosum* Mart.	40	Leaf	Globose	Green	Glabrous	L ± 0.1; W ± 0.1	S	Cecidomyiidae	
Euphorbiaceae	Euphorbiaceae sp.	41	Stem/Petiole	Fusiform	Red	Glabrous	L ± 3.0; W ± 0.5	F	Unidentified	Eulophidae/ Eurytomidae
Euphorbiaceae	*Manihot* sp.	42	Leaf	Conical	Yellow	Glabrous	L ± 1.0; W ± 0.3	S	*Iatrophobia* sp.	Pteromalidae
Euphorbiaceae	*Manihot* sp.	43	Leaf	Conical	Yellow	Glabrous	L ± 0.7; W ± 0.2	S	*Iatrophobia* sp.	
Euphorbiaceae	*Maprounea guianensis* Aubl.	44	Stem	Fusiform	Red	Glabrous	L ± 0.7; W ± 0.5	S	Unidentified	
Fabaceae	*Acosmium dasycarpum* (Vogel) Yakovlev	45	Leaf	Discoid	Green	Glabrous	L ± 0.5; W ± 0.5	S	Cecidomyiidae	
Fabaceae	*Bauhinia brevipes* Vogel.	46	Leaf	Discoid	Yellow	Hairy	L ± 0.1; W ± 0.1	S	Cecidomyiidae	
Fabaceae	*Bauhinia brevipes* Vogel.	47	Leaf	Globose	Yellow	Hairy	L ± 0.2; W ± 0.2	S	Cecidomyiidae	
Fabaceae	*Bauhinia brevipes* Vogel.	48	Leaf	Globose	Yellow	Hairy	L ± 0.1; W ± 0.1	S	Cecidomyiidae	
Fabaceae	*Bauhinia brevipes* Vogel.	49	Leaf	Globose	Brown	Hairy	L ± 0.4; W ± 0.4	S	Cecidomyiidae	
Fabaceae	*Bauhinia brevipes* Vogel.	50	Stem	Fusiform	Green	Hairy	L ± 5.5; W ± 0.6	S	Cecidomyiidae	Eulophidae/ Braconidae

Host plants			Insect gall morphotypes						Insect taxa	
Family	Species	Gall	Organ	Form	Colour	Pubescence	Size (cm)	Vegetation	Gall-inducers	Parasitoids or inquilines
Fabaceae	*Bauhinia brevipes* Vogel.	51	Stem	Fusiform	Brown	Hairy	L ± 1.8; W ± 0.8	S	Cecidomyiidae	
Fabaceae	*Bauhinia curvula* Benth.	52	Leaf	Globose	Green	Hairy	L ± 0.8; W ± 0.4	S	Cecidomyiidae	
Fabaceae	*Bauhinia curvula* Benth.	53	Stem	Fusiform	Brown	Glabrous	L ± 3.0; W ± 1.0	S	Cecidomyiidae	
Fabaceae	*Bauhinia* sp.	54	Apical bud	Fusiform	Green	Hairy	L ± 1.0; W ± 1.3	S	Unidentified	
Fabaceae	*Bauhinia* sp.	55	Leaf	Fusiform	Green	Hairy	L ± 0.4; W ± 0.3	S	Cecidomyiidae	Eulophidae/ Braconidae/ Pteromalidae
Fabaceae	*Bauhinia* sp.	56	Leaf	Globose	Green	Hairy	L ± 0.5; W ± 0.5	S	Cecidomyiidae	
Fabaceae	*Bauhinia* sp.	57	Leaf	Globose	Yellow	Hairy	L ± 0.2; W ± 0.2	S	Unidentified	
Fabaceae	*Bauhinia* sp.	58	Leaf	Globose	Brown	Hairy	L ± 0.2; W ± 0.2	F	Unidentified	
Fabaceae	*Bauhinia* sp.	59	Stem	Fusiform	Brown	Glabrous	L ± 2.0; W ± 0.8	F	Unidentified	Braconidae
Fabaceae	*Bauhinia* sp.	60	Stem	Globose	Brown	Hairy	L ± 2.5; W ± 2.0	S	Lepidoptera	Torymidae
Fabaceae	Fabaceae sp.	61	Leaf	Discoid	Red	Glabrous	L ± 0.4; W ± 0.4	F	Unidentified	
Fabaceae	Fabaceae sp.	62	Leaf	Globose	Green	Glabrous	L ± 0.2; W ± 0.2	F	Unidentified	
Fabaceae	Fabaceae sp.	63	Leaf	Globose	Yellow	Glabrous	L ± 0.3; W ± 0.3	S	Unidentified	
Fabaceae	Fabaceae sp.	64	Leaf	Globose	Green	Hairy	L ± 0.3; W ± 0.3	S	Unidentified	
Fabaceae	Fabaceae sp.	65	Petiole	Globose	Green	Glabrous	L ± 0.3; W ± 0.3	F	Unidentified	
Fabaceae	*Sclerolobium paniculatum* Vogel.	66	Leaf	Globose	Green	Hairy	L ± 0.1; W ± 0.1	S	Unidentified	
Lamiaceae	Lamiaceae sp.	67	Midvein	Fusiform	Green	Hairy	L ± 0.4; W ± 0.2	S	Unidentified	
Lamiaceae	Lamiaceae sp.	68	Stem	Fusiform	Brown	Hairy	L ± 1.5; W ± 0.5	S	Unidentified	
Lauraceae	Lauraceae sp.	69	Leaf	Globose	Green	Glabrous	L ± 0.5; W ± 0.5	F	Unidentified	
Lauraceae	*Nectandra cuspidata* Nees & Mart.	70	Leaf	Discoid	White	Hairy	L ± 0.3; W ± 0.3	F	Cecidomyiidae	Eulophidae
Lauraceae	*Nectandra cuspidata* Nees & Mart.	71	Leaf	Discoid	Green	Glabrous	L ± 0.9; W ± 0.9	F	Phlaeothripidae	
Lauraceae	*Nectandra cuspidata* Nees & Mart.	72	Leaf	Globose	Brown	Hairy	L ± 0.4; W ± 0.4	F	Unidentified	Eulophidae
Lorantaceae	Lorantaceae sp.	73	Leaf	Discoid	Green	Glabrous	L ± 0.5; W ± 0.5	F	Unidentified	
Lythraceae	*Diplusodon* sp.	74	Stem/Petiole	Fusiform	White	Glabrous	L ± 1.0; W ± 0.4	F	Unidentified	
Malpighiaceae	*Byrsonima* sp.	75	Leaf	Conical	Green	Hairy	L ± 0.4; W ± 0.2	S	Cecidomyiidae	
Malpighiaceae	*Diplopterys pubipetala* (A. Juss.) W.R.Anderson & C.Davis	76	Leaf	Conical	Green	Glabrous	L ± 1.0; W ± 0.3	S/F	Phlaeothripidae	Eulophidae
Malpighiaceae	*Diplopterys pubipetala* (A. Juss.) W.R.Anderson & C.Davis	77	Leaf	Discoid	Green	Glabrous	L ± 0.5; W ± 0.5	F	Unidentified	Eurytomidae
Malpighiaceae	*Diplopterys pubipetala* (A. Juss.) W.R.Anderson & C.Davis	78	Leaf	Discoid	Green	Glabrous	L ± 0.6; W ± 0.6	S	Unidentified	
Malpighiaceae	*Heteropterys eglandulosa* A. Juss.	79	Leaf	Discoid	Yellow	Hairy	L ± 0.3; W ± 0.3	S	Unidentified	
Malpighiaceae	*Heteropterys* sp.	80	Leaf	Amophous	Yellow	Glabrous	L ± 1.5; W ± 0.7	S	Unidentified	Eulophidae
Malpighiaceae	Malpighiaceae sp.	81	Apical bud	Fusiform	Green	Glabrous	L ± 2.5; W ± 2.0	F	Unidentified	
Malpighiaceae	Malpighiaceae sp.	82	Leaf	Discoid	Green	Glabrous	L ± 0.6; W ± 0.6	F	Phlaeothripidae	Eulophidae
Malpighiaceae	Malpighiaceae sp.	83	Stem	Globose	Brown	Glabrous	L ± 2.5; W ± 2.5	F	Cecidomyiidae	
Malpighiaceae	Malpighiaceae sp.	84	Leaf	Globose	Green	Glabrous	L ± 0.5; W ± 0.5	F	Unidentified	
Malpighiaceae	Malpighiaceae sp.	85	Leaf	Globose	Green	Glabrous	L ± 0.5; W ± 0.4	F	Unidentified	
Malpighiaceae	Malpighiaceae sp.	86	Stem	Globose	Brown	Glabrous	L ± 2.0; W ± 1.5	S	Cecidomyiidae	
Malpighiaceae	*Peixotoa* sp.	87	Leaf	Globose	Brown	Hairy	L ± 0.6; W ± 0.6	S	Cecidomyiidae	Eulophidae
Melastomataceae	Melastomataceae sp.	88	Leaf/Petiole	Globose	Green	Hairy	L ± 0.5; W ± 0.5	F	Unidentified	
Melastomataceae	Melastomataceae sp.	89	Stem	Fusiform	Brown	Glabrous	L ± 3.5; W ± 1.3	S	Unidentified	Torymidae
Melastomataceae	Melastomataceae sp.	90	Stem	Fusiform	Brown	Glabrous	L ± 5.0; W ± 2.3	S	Unidentified	
Melastomataceae	*Miconia* sp.	91	Leaf	Discoid	Green	Hairy	L ± 0.5; W ± 0.5	F	Unidentified	
Melastomataceae	*Miconia* sp.	92	Leaf	Globose	Brown	Hairy	L ± 0.2; W ± 0.2	S	Lepidoptera	
Melastomataceae	*Tibouchina* sp.	93	Stem	Fusiform	Brown	Glabrous	L ± 2.0; W ± 1.0	S	Lepidoptera	
Meliaceae	*Trichilia* sp.	94	Leaf	Discoid	Yellow	Glabrous	L ± 0.1; W ± 0.1	F	Unidentified	
Meliaceae	*Trichilia* sp.	95	Midvein	Fusiform	Yellow	Glabrous	L ± 0.9; W ± 0.3	F	Unidentified	
Meliaceae	*Trichilia* sp.	96	Stem	Fusiform	Brown	Glabrous	L ± 2.6; W ± 0.6	F	Unidentified	Eulophidae
Myristicaceae	Myristicaceae sp.	97	Leaf	Conical	Brown	Hairy	L ± 0.4; W ± 0.4	F	Unidentified	
Myrtaceae	*Myrcia* sp.	98	Leaf	Amophous	Yellow	Glabrous	L ± 1.0; W ± 1.0	F	Phlaeothripidae	
Myrtaceae	*Myrcia* sp.	99	Leaf	Discoid	Green	Glabrous	L ± 0.3; W ± 0.2	F	Cecidomyiidae	
Myrtaceae	*Myrcia* sp.	100	Leaf	Globose	Green	Hairy	L ± 0.1; W ± 0.1	F	Cecidomyiidae	
Myrtaceae	*Myrcia* sp.	101	Stem	Fusiform	Brown	Glabrous	L ± 1.0; W ± 0.5	F	Unidentified	Eurytomidae
Myrtaceae	*Myrcia* sp.	102	Stem	Fusiform	Brown	Glabrous	L ± 2.0; W ± 1.0	F	Unidentified	
Myrtaceae	*Myrcia* sp.	103	Stem	Fusiform	Brown	Glabrous	L ± 3.5; W ± 0.7	F	Unidentified	
Myrtaceae	*Myrcia* sp.	104	Stem	Fusiform	Brown	Glabrous	L ± 4.0; W ± 0.6	F	Unidentified	
Myrtaceae	Myrtaceae sp.	105	Leaf bud	Globose	Green	Hairy	L ± 1.3; W ± 1.3	S	Cecidomyiidae	

Host plants			Insect gall morphotypes						Insect taxa	
Family	Species	Gall	Organ	Form	Colour	Pubescence	Size (cm)	Vegetation	Gall-inducers	Parasitoids or inquilines
Myrtaceae	Myrtaceae sp.	106	Stem	Globose	Brown	Glabrous	L ± 0.5; W ± 0.5	S	Unidentified	
Nyctaginaceae	*Guapira* sp.	107	Leaf	Discoid	Red	Glabrous	L ± 0.5; W ± 0.5	S	Cecidomyiidae	Eulophidae
Ochnaceae	*Ouratea hexasperma* (A. St.-Hil.) Baill.	108	Leaf	Discoid	Red	Glabrous	L ± 0.3; W ± 0.3	S	Cecidomyiidae	
Proteaceae	*Roupala montana* Aubl.	109	Leaf	Conical	Green	Hairy	L ± 0.7; W ± 0.3	S	Cecidomyiidae	Eulophidae
Proteaceae	*Roupala Montana* Aubl.	110	Leaf	Discoid	Green	Hairy	L ± 0.4; W ± 0.4	S	Cecidomyiidae	
Proteaceae	*Roupala montana* Aubl.	111	Stem	Globose	Brown	Glabrous	L ± 1.3; W ± 1.3	S	Lepidoptera	
Rhamnaceae	*Rhamnidium* sp.	112	Lateral bud	Globose	Brown	Glabrous	L ± 1.0; W ± 0.7	F	Unidentified	
Rubiaceae	*Landia* sp.	113	Leaf	Fusiform	Green	Glabrous	L ± 0.8; W ± 0.3	F	Unidentified	
Rubiaceae	Rubiaceae sp.	114	Leaf	Fusiform	Yellow	Hairy	L ± 0.2; W ± 0.1	F	Unidentified	
Rubiaceae	Rubiaceae sp.	115	Leaf	Globose	Green	Glabrous	L ± 0.1; W ± 0.1	F	Unidentified	
Rubiaceae	Rubiaceae sp.	116	Leaf	Globose	Yellow	Glabrous	L ± 0.3; W ± 0.3	F	Unidentified	
Rubiaceae	Rubiaceae sp.	117	Stem	Fusiform	Brown	Glabrous	L ± 1.2; W ± 0.6	F	Unidentified	
Rutaceae	*Zanthoxylum* sp.	118	Leaf	Discoid	Green	Hairy	L ± 0.1; W ± 0.1	S	Unidentified	
Santalaceae	*Phoradendron* sp.	119	Leaf	Discoid	Green	Glabrous	L ± 0.2; W ± 0.2	F	Unidentified	
Sapindaceae	*Paullinia* sp.	120	Axilary bud	Globose	Green	Hairy	L ± 0.7; W ± 0.7	F	Unidentified	Eulophidae
Sapindaceae	*Paullinia* sp.	121	Stem	Conical	Red	Hairy	L ± 0.3; W ± 0.2	F	Unidentified	
Sapindaceae	Sapindaceae sp.	122	Leaf	Discoid	Yellow	Glabrous	L ± 0.3; W ± 0.3	F	Unidentified	
Sapindaceae	Sapindaceae sp.	123	Leaf	Globose	Green	Glabrous	L ± 0.3; W ± 0.3	S	Unidentified	
Sapindaceae	Sapindaceae sp.	124	Leaf	Globose	Green	Glabrous	L ± 0.2; W ± 0.2	S	Unidentified	
Sapindaceae	Sapindaceae sp.	125	Stem	Conical	Green	Glabrous	L ± 1.3; W ± 0.5	F	Unidentified	Eulophidae
Sapindaceae	*Serjania* sp.	126	Leaf	Discoid	Green	Glabrous	L ± 0.8; W ± 0.2	F	Cecidomyiidae	
Sapindaceae	*Serjania* sp.	127	Leaf	Discoid	Green	Glabrous	L ± 0.5; W ± 0.5	S	Cecidomyiidae	
Sapindaceae	*Serjania* sp.	128	Leaf	Discoid	Yellow	Glabrous	L ± 0.5; W ± 0.5	S	Cecidomyiidae	
Sapindaceae	*Serjania* sp.	129	Stem	Fusiform	Brown	Hairy	L ± 2.5; W ± 1.5	F	Cecidomyiidae	Eurytomidae
Sapindaceae	*Serjania* sp.	130	Tendril	Fusiform	Brown	Glabrous	L ± 2.0; W ± 1.7	F	Cecidomyiidae	
Siparunaceae	*Siparuna guianensis* Aubl.	131	Leaf	Discoid	Green	Glabrous	L ± 0.5; W ± 0.5	F	Cecidomyiidae	
Siparunaceae	*Siparuna guianensis* Aubl.	132	Leaf	Fusiform	Green	Glabrous	L ± 0.6; W ± 0.4	F	Cecidomyiidae	
Siparunaceae	*Siparuna guianensis* Aubl.	133	Midvein	Fusiform	Green	Glabrous	L ± 0.5; W ± 0.3	F	Cecidomyiidae	
Siparunaceae	*Siparuna guianensis* Aubl.	134	Petiole	Globose	Brown	Glabrous	L ± 0.4; W ± 0.4	F	Cecidomyiidae	
Siparunaceae	*Siparuna guianensis* Aubl.	135	Stem	Fusiform	Green	Glabrous	L ± 1.0; W ± 0.7	F	Cecidomyiidae	
Siparunaceae	*Siparuna guianensis* Aubl.	136	Stem	Globose	Brown	Glabrous	L ± 0.4; W ± 0.4	F	Cecidomyiidae	Eurytomidae
Siparunaceae	*Siparuna guianensis* Aubl.	137	Stem/Petiole	Fusiform	Green	Glabrous	L ± 2.0; W ± 0.6	F	Cecidomyiidae	
Smilacaceae	*Smilax* sp.	138	Leaf	Globose	Yellow	Glabrous	L ± 0.2; W ± 0.2	S	Unidentified	Eulophidae/ Torymidae
Smilacaceae	*Smilax* sp.	139	Leaf	Globose	Green	Glabrous	L ± 0.6; W ± 0.6	S	Unidentified	
Smilacaceae	*Smilax* sp.	140	Leaf/Stem	Fusiform	White	Glabrous	L ± 2.5; W ± 2.0	F	Unidentified	
Styracaceae	*Styrax pohlii* A. DC.	141	Leaf	Discoid	Yellow	Glabrous	L ± 0.1; W ± 0.1	F	Cecidomyiidae	
Vitaceae	*Cissus erosa* Rich.	142	Stem	Globose	Brown	Glabrous	L ± 4.0; W ± 3.3	S	Curculionidae	
Vitaceae	*Cissus* sp.	143	Leaf	Globose	Green	Glabrous	L ± 0.4; W ± 0.4	F	Unidentified	
Vitaceae	Vitaceae sp.	144	Stem/Petiole	Globose	Green	Hairy	L ± 0.4; W ± 0.4	S	Unidentified	
Vochysiaceae	*Qualea dichotoma* (Mart.) Warm. ex Wille	145	Leaf	Globose	Green	Hairy	L ± 0.2; W ± 0.2	F	Cecidomyiidae	
Vochysiaceae	*Qualea grandiflora* Mart.	146	Leaf	Discoid	Yellow	Glabrous	L ± 0.3; W ± 0.3	S	Cecidomyiidae	
Vochysiaceae	*Qualea multiflora* Mart.	147	Leaf	Globose	Green	Hairy	L ± 0.4; W ± 0.4	F/S	Cecidomyiidae	Eulophidae
Vochysiaceae	*Qualea multiflora* Mart.	148	Leaf	Globose	Yellow	Hairy	L ± 0.6; W ± 0.6	F/S	Cecidomyiidae	Braconidae/ Eulophidae
Vochysiaceae	*Qualea parviflora* Mart.	149	Leaf	Discoid	Green	Glabrous	L ± 0.2; W ± 0.2	S	Cecidomyiidae	
Vochysiaceae	*Qualea parviflora* Mart.	150	Leaf	Globose	Yellow	Glabrous	L ± 0.4; W ± 0.4	S	Cecidomyiidae	Encyrtidae

Table 4. Number and percentage of insect gall morphotypes in the different taxa of galling insects recorded in EA-CEFAEH, Hidrolândia, Goiás, Brazil.

Galling insect taxa	Insect gall morphotypes	
	N	%
Cecidomyiidae (Diptera)	72	48.1
Lepidoptera	6	4.0
Thysanoptera (Phlaeothripidae)	4	2.6
Coleoptera	1	0.6
Unidentified	67	44.7
TOTAL	**150**	**100**

pubipetala (Malpighiaceae) and the two gall morphotypes (Galls 147 and 148) recorded on *Qualea multiflora* (Vochysiaceae) were common between savanna and forest sites. Comparisons between different vegetation types in the Cerrado have pointed higher insect gall richness in the sclerophyllous habitats, with savannas often have greater species richness than the forests (Gonçalves-Alvim & Fernandes, 2001; Araújo *et al.,* 2011; Araújo *et al.,* 2014a). Our results corroborate the pattern of higher frequency of insect galls in xeric habitats than

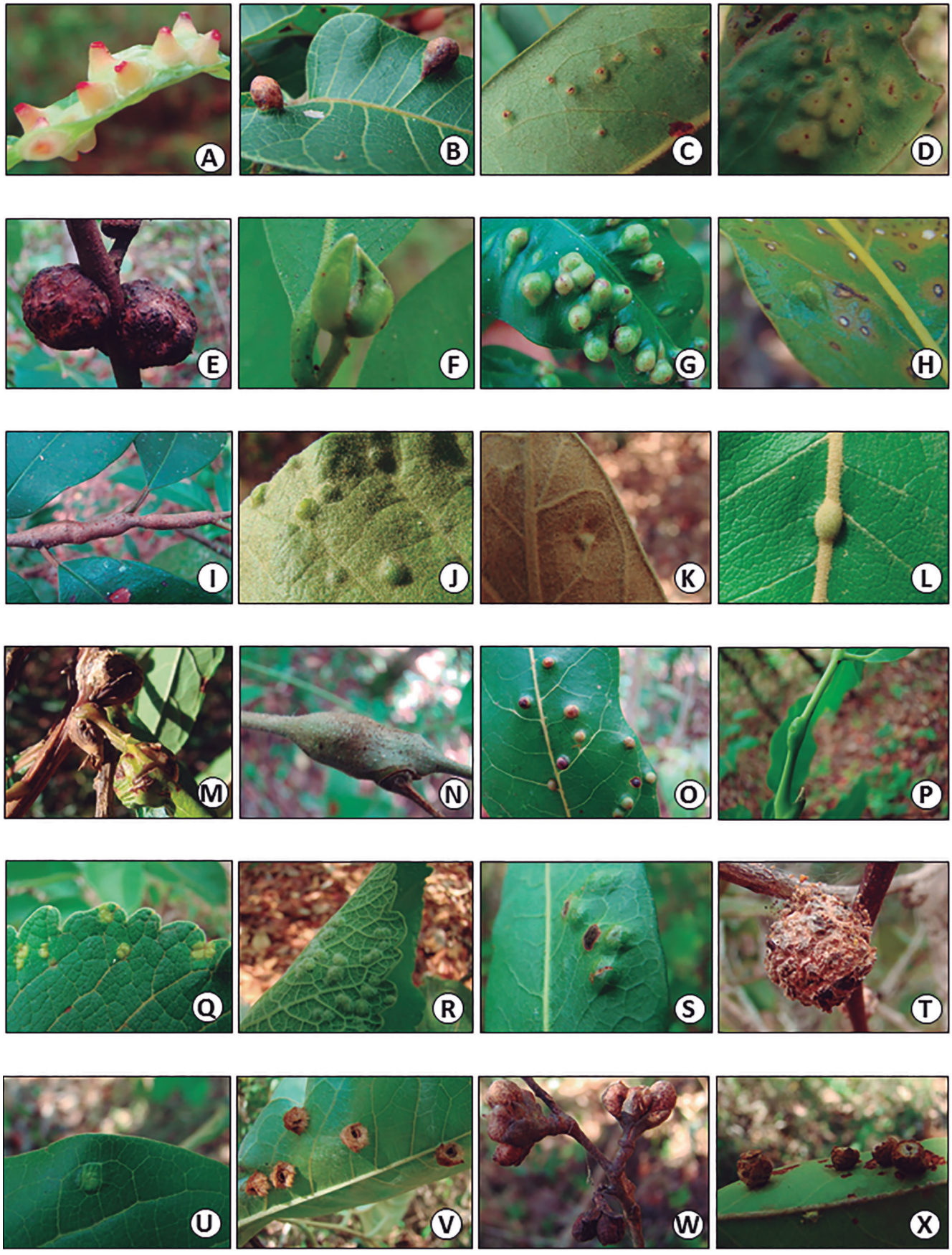

Figure 2. Insect gall morphotypes recorded in EA-CEFAEH, Hidrolândia, Goiás, Brazil. (A) *Anacardium humile* (Gall 1), (B) *Myracrodruon urundeuva* (Gall 2), (C) Annonaceae sp. (Gall 3), (D) Annonaceae sp. (Gall 4), (E) Annonaceae sp. (Gall 5), (F) *Cardiopetalum* sp. (Gall 6), (G) *Aspidosperma* sp. (Gall 7), (H) *Aspidosperma* sp. (Gall 8), (I) *Aspidosperma* sp. (Gall 9), (J) *Aspidosperma tomentosum* (Gall 10), (K) *Schefflera macrocarpa* (Gall 11), (L) Asteraceae sp. (Gall 12), (M) Asteraceae sp. (Gall 13), (N) *Fridericia* sp. (Gall 14), (O) *Protium* sp. (Gall 15), (P) *Protium* sp. (Gall 16), (Q) *Caryocar brasiliense* (Gall 17), (R) *C. brasiliense* (Gall 18), (S) Celastraceae sp. (Gall 19), (T) *Plenckia populnea* (Gall 20), (U) *Terminalia argentea* Mart. (Gall 21), (V) *T. argentea* (Gall 22), (W) Connaraceae sp. (Gall 23), (X) *Connarus* sp. (Gall 24).

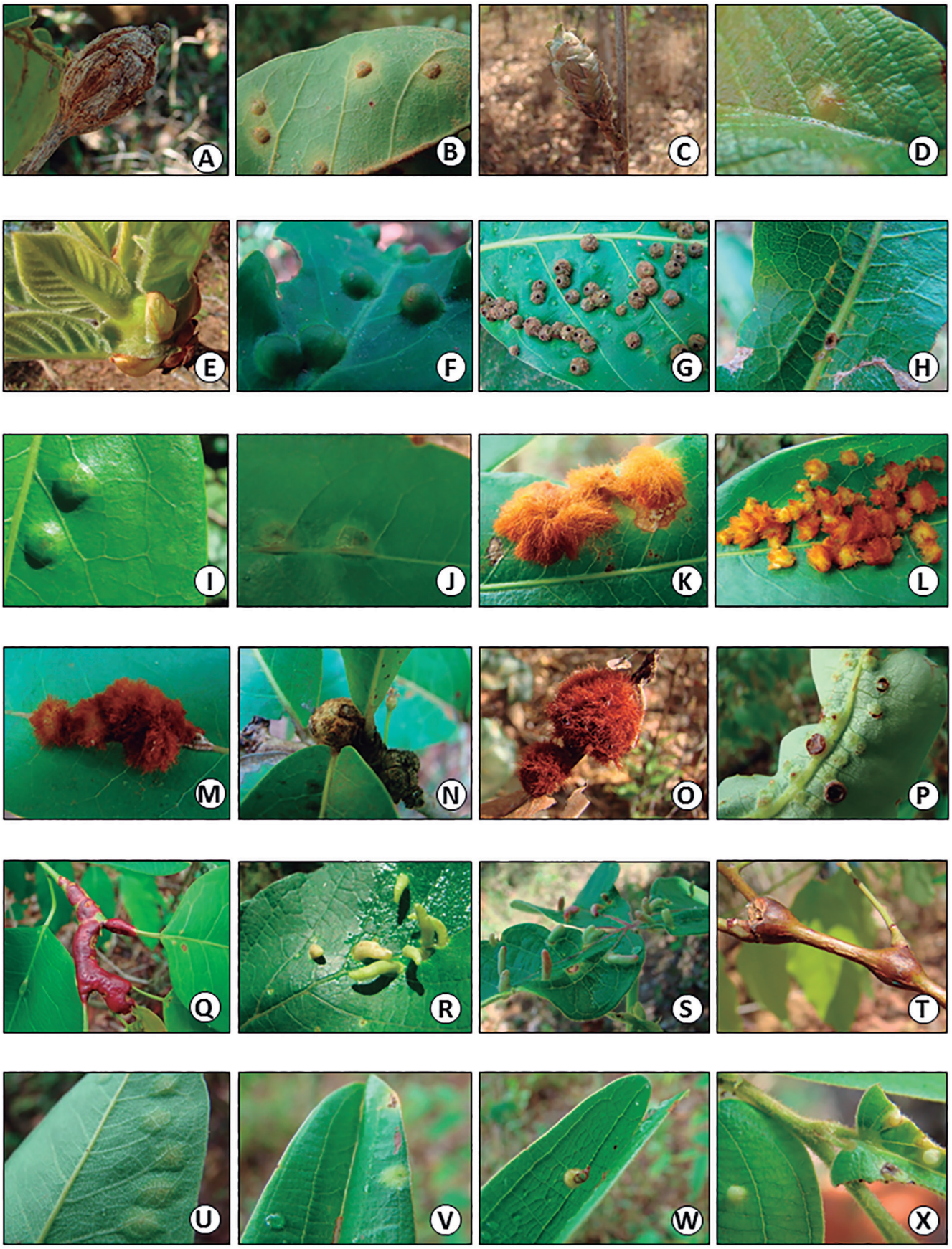

Figure 3. Insect gall morphotypes recorded in EA-CEFAEH, Hidrolândia, Goiás, Brazil. (A) *Connarus* sp. (Gall 25), (B) *Connarus suberosus* (Gall 26), (C) *Davilla* sp. (Gall 27), (D) *Davilla* sp. (Gall 28), (E) *Diospyros hispida* (Gall 29), (F) *Sloanea* sp. (Gall 30), (G) *Sloanea* sp. (Gall 31), (H) *Erythroxylum* sp. (Gall 32), (I) *Erythroxylum* sp. (Gall 33), (J) *Erythroxylum* sp. (Gall 34), (K) *Erythroxylum* sp. (Gall 35), (L) *Erythroxylum* sp. (Gall 36), (M) *Erythroxylum* sp. (Gall 37), (N) *Erythroxylum* sp. (Gall 38), (O) *Erythroxylum suberosum* (Gall 39), (P) *Erythroxylum tortuosum* (Gall 40), (Q) Euphorbiaceae sp. (Gall 41), (R) *Manihot* sp. (Gall 42), (S) *Manihot* sp. (Gall 43), (T) *Maprounea guianensis* (Gall 44), (U) *Acosmium dasycarpum* (Gall 45), (V) *Bauhinia brevipes* (Gall 46), (W) *B. brevipes* (Gall 47), (X) *B. brevipes* (Gall 48).

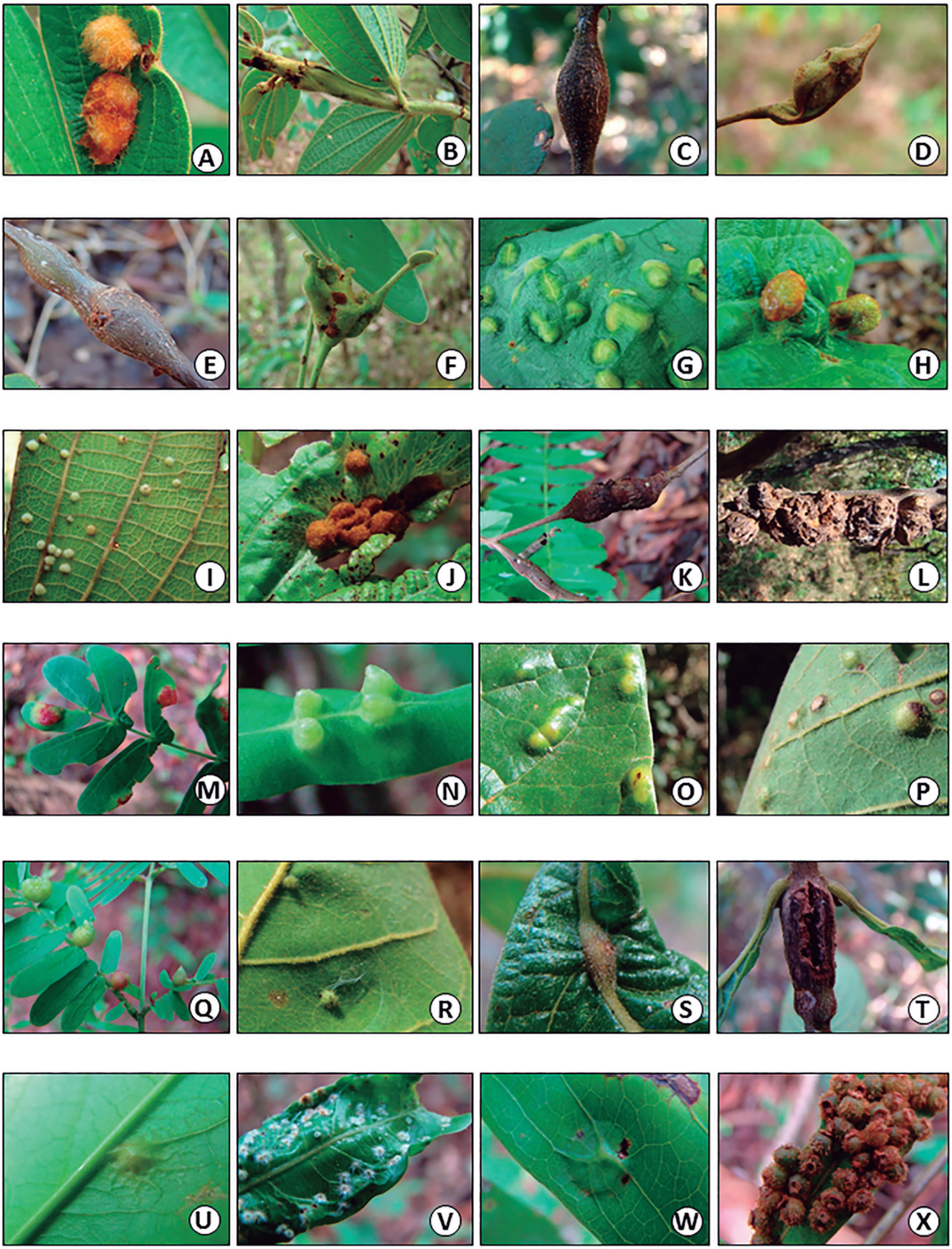

Figure 4. Insect gall morphotypes recorded in EA-CEFAEH, Hidrolândia, Goiás, Brazil. (A) *B. brevipes* (Gall 49), (B) *B. brevipes* (Gall 50), (C) *B. brevipes* (Gall 51), (D) *Bauhinia curvula* (Gall 52), (E) *B. curvula* (Gall 53), (F) *Bauhinia* sp. (Gall 54), (G) *Bauhinia* sp. (Gall 55), (H) *Bauhinia* sp. (Gall 56), (I) *Bauhinia* sp. (Gall 57), (J) *Bauhinia* sp. (Gall 58), (K) *Bauhinia* sp. (Gall 59), (L) *Bauhinia* sp. (Gall 60), (M) Fabaceae sp. (Gall 61), (N) Fabaceae sp. (Gall 62), (O) Fabaceae sp. (Gall 63), (P) Fabaceae sp. (Gall 64), (Q) Fabaceae sp. (Gall 65), (R) *Sclerolobium paniculatum* (Gall 66), (S) Lamiaceae sp. (67), (T) Lamiaceae sp. (Gall 68), (U) Lauraceae sp. (Gall 69), (V) *Nectandra cuspidata* (Gall 70), (W) *N. cuspidata* (Gall 71), (X) *N. cuspidata* (Gall 72).

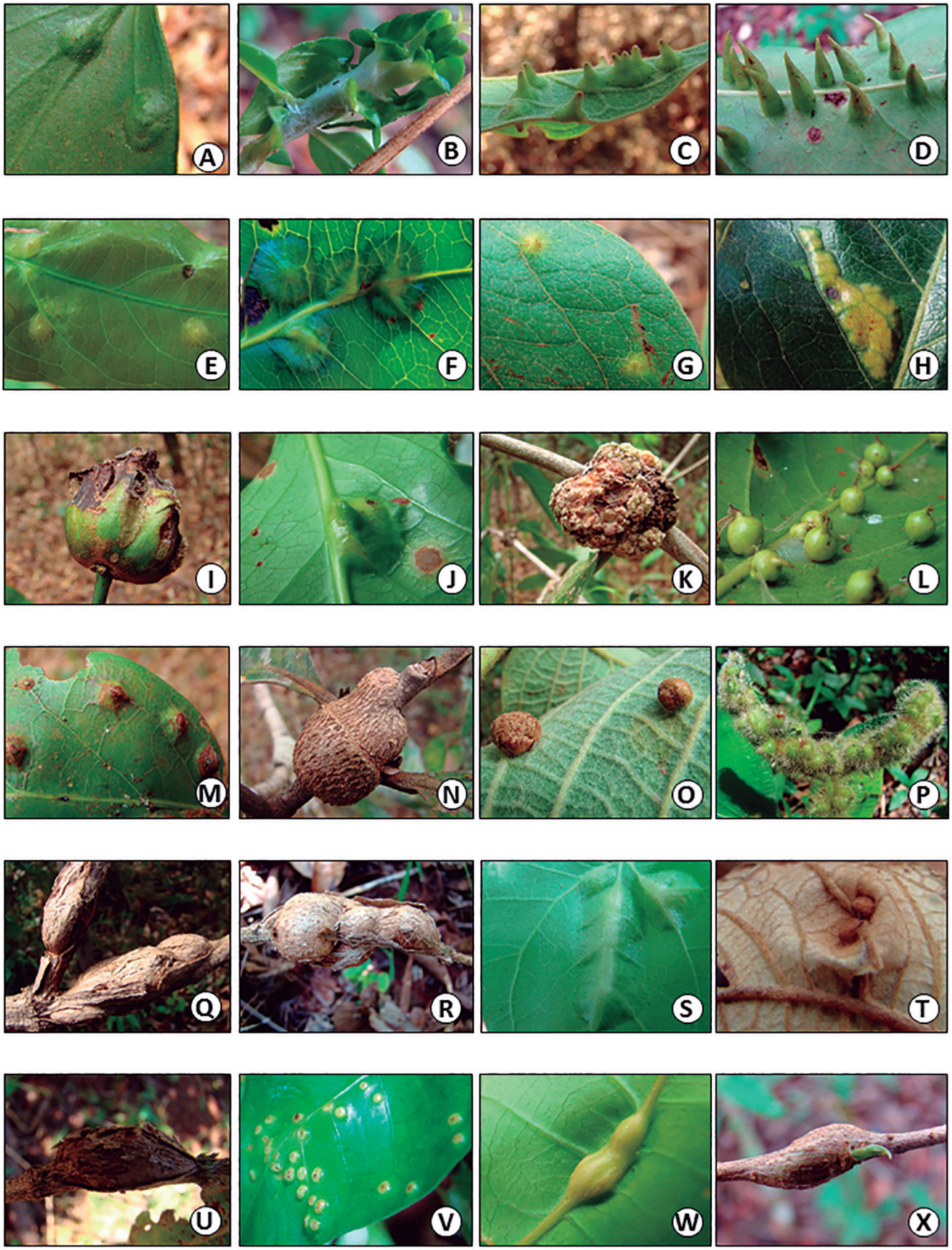

Figure 5. Insect gall morphotypes recorded in EA-CEFAEH, Hidrolândia, Goiás, Brazil. (A) Lorantaceae sp. (Gall 73), (B) *Diplusodon* sp. (Gall 74), (C) *Byrsonima* sp. (Gall 75), (D) *Diplopterys pubipetala* (Gall 76), (E) *D. pubipetala* (Gall 77), (F) *D. pubipetala* (Gall 78), (G) *Heteropterys eglandulosa* (Gall 79), (H) *Heteropterys* sp. (Gall 80), (I) Malpighiaceae sp. (Gall 81), (J) Malpighiaceae sp. (Gall 82), (K) Malpighiaceae sp. (Gall 83), (L) Malpighiaceae sp. (Gall 84), (M) Malpighiaceae sp. (Gall 85), (N) Malpighiaceae sp. (Gall 86), (O) *Peixotoa* sp. (Gall 87), (P) Melastomataceae sp. (Gall 88), (Q) Melastomataceae sp. (Gall 89), (R) Melastomataceae sp. (Gall 90), (S) *Miconia* sp. (Gall 91), (T) *Miconia* sp. (Gall 92), (U) *Tibouchina* sp. (Gall 93), (V) *Trichilia* sp. (Gall 94), (W) *Trichilia* sp. (Gall 95), (X) *Trichilia* sp. (Gall 96).

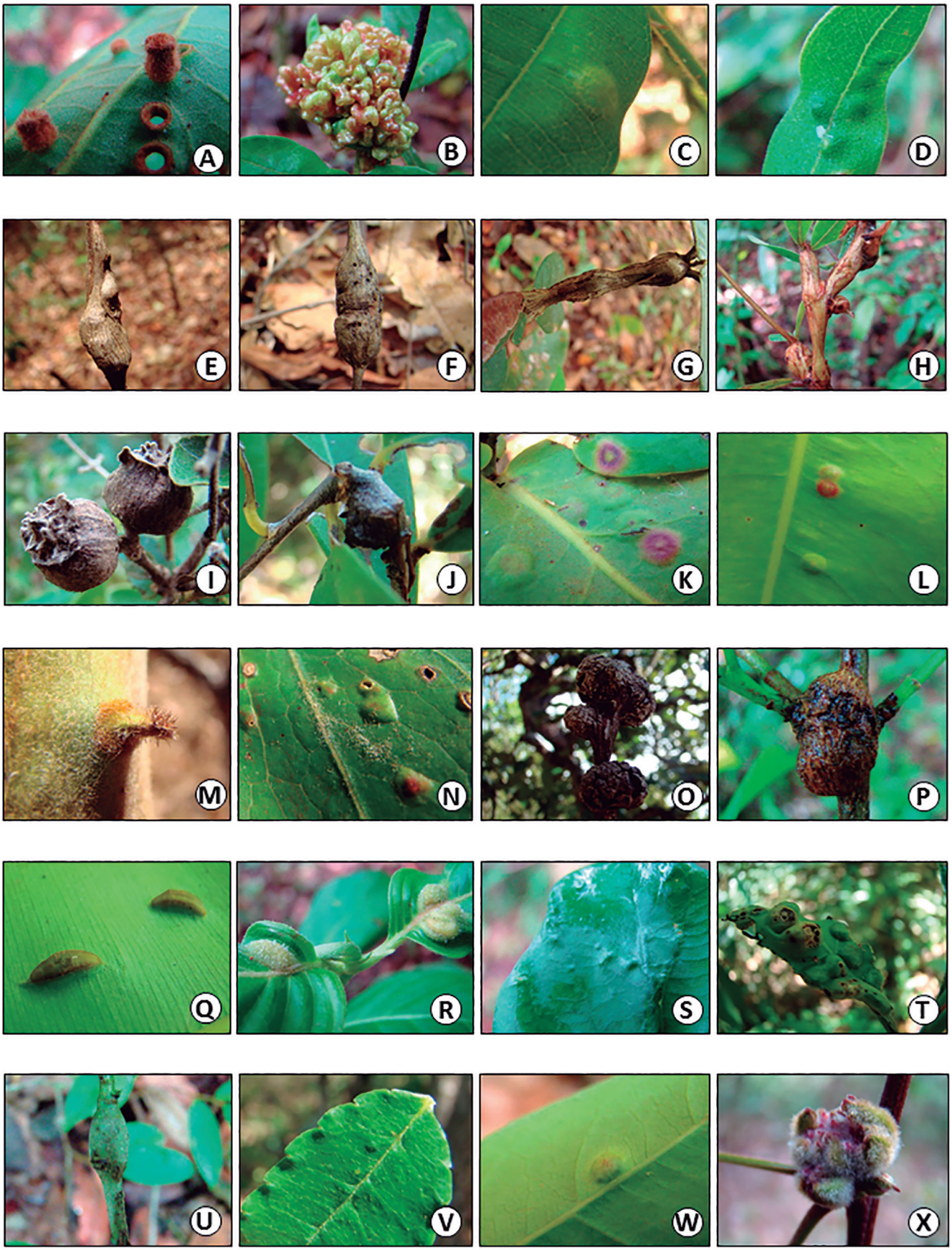

Figure 6. Insect gall morphotypes recorded in EA-CEFAEH, Hidrolândia, Goiás, Brazil. (A) Myristicaceae sp. (Gall 97), (B) *Myrcia* sp. (Gall 98), (C) *Myrcia* sp. (Gall 99), (D) *Myrcia* sp. (Gall 100), (E) *Myrcia* sp. (Gall 101), (F) *Myrcia* sp. (Gall 102), (G) *Myrcia* sp. (Gall 103), (H) *Myrcia* sp. (Gall 104), (I) Myrtaceae sp. (Gall 105), (J) Myrtaceae sp. (Gall 106), (K) *Guapira* sp. (Gall 107), (L) *Ouratea hexasperma* (Gall 108), (M) *Roupala montana* (Gall 109), (N) *R. montana* (Gall 110), (O) *R. montana* (Gall 111), (P) *Rhamnidium* sp. (Gall 112), (Q) *Landia* sp. (Gall 113), (R) Rubiaceae sp. (Gall 114), (S) Rubiaceae sp. (Gall 115), (T) Rubiaceae sp. (116), (U) Rubiaceae sp. (Gall 117), (V) *Zanthoxylum* sp. (Gall 118), (W) *Phoradendron* sp. (Gall 119), (X) *Paullinia* sp. (Gall 120).

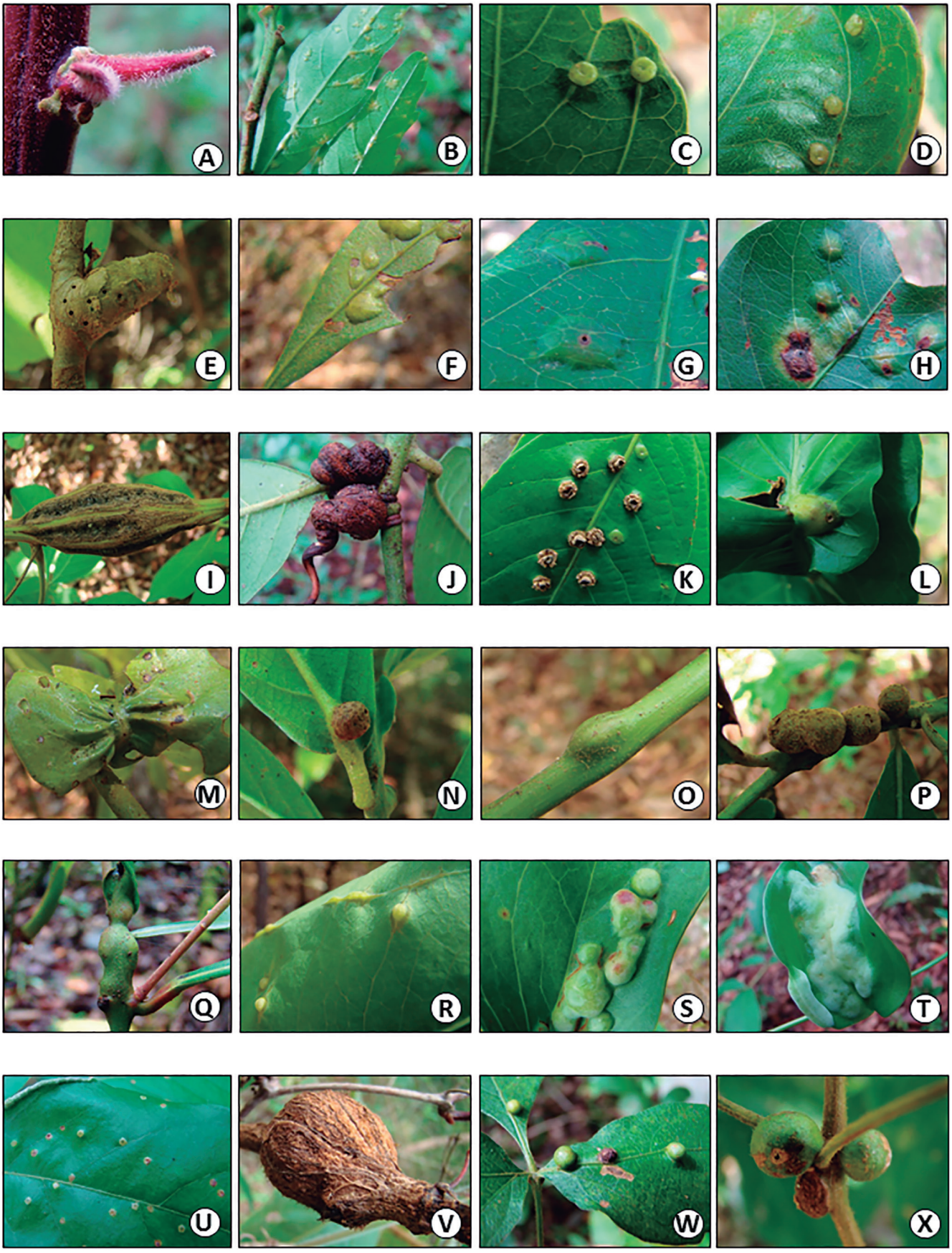

Figure 7. Insect gall morphotypes recorded in EA-CEFAEH, Hidrolândia, Goiás, Brazil. (A) *Paullinia* sp. (Gall 121), (B) Sapindaceae sp. (Gall 122), (C) Sapindaceae sp. (Gall 123), (D) Sapindaceae sp. (Gall 124), (E) Sapindaceae sp. (Gall 125), (F) *Serjania* sp. (Gall 126), (G) *Serjania* sp. (Gall 127), (H) *Serjania* sp. (Gall 128), (I) *Serjania* sp. (Gall 129), (J) *Serjania* sp. (Gall 130), (K) *Siparuna guianensis* (Gall 131), (L) *S. guianensis* (Gall 132), (M) *S. guianensis* (Gall 133), (N) *S. guianensis* (Gall 134), (O) *S. guianensis* (Gall 135), (P) *S. guianensis* (Gall 136), (Q) *S. guianensis* (Gall 137), (R) *Smilax* sp. (Gall 138), (S) *Smilax* sp. (Gall 139), (T) *Smilax* sp. (Gall 140), (U) *Styrax pohlii* A. DC. (Gall 141), (V) *Cissus erosa* (Gall 142), (W) *Cissus* sp. (Gall 143), (X) Vitaceae sp. (Gall 144).

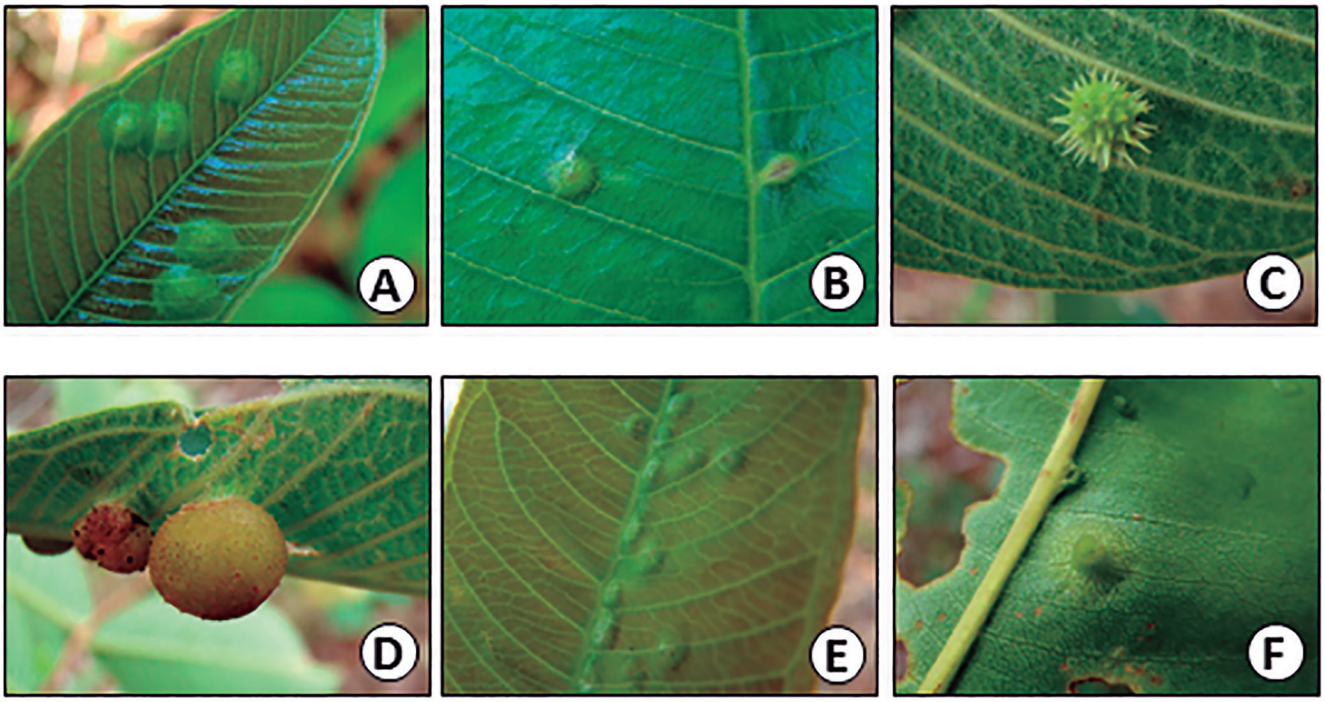

Figure 8. Insect gall morphotypes recorded in EA-CEFAEH, Hidrolândia, Goiás, Brazil. (A) *Qualea dichotoma* (Gall 145), (B) *Qualea grandiflora* (Gall 146), (C) *Qualea multiflora* (Gall 147), (D) *Q. multiflora* (Gall 148), (E) *Qualea parviflora* (Gall 149), (F) *Q. parviflora* (Gall 150).

in mesics (although it was not the objective of the work to test statistically these differences). Among the possible explanations to this pattern are that in xeric environments the plants are more nutritive to galling insects and the attack frequency of natural enemies (*e.g.,* parasitoids) is lower as compared to mesic habitats, as predicted by hydrothermal stress hypothesis at community level (Fleck & Fonseca, 2007; Araújo *et al.,* 2014a).

CONCLUSIONS

This is the first systematic survey of insect galls realized in the EA-CEFAEH and region of Hidrolândia city. Although the study area is relatively anthropized and little fragments, the sampled sites presented great insect gall richness as compared to other sites cataloged to the Central region of Brazil. The EA-CEFAEH area had more insect gall morphotypes than the Parque Estadual da Serra dos Pireneus (62, Araújo *et al.,* 2011) and Parque Nacional das Emas (97, Araújo *et al.,* 2014b). Despite the possible effects of sampling effort differences between these studies, as previously discussed, our results show that any vegetation fragment can be a potential shelter to conserve insect galls. Finally, the observed results about host plant taxa, galling insect groups, gall morphology and occurrence between vegetation types confirm the known patterns of Brazilian Cerrado.

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